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BIRDS AND BURNS NETWORK – ANALYSIS OF FIRE EFFECTS ON POPULATIONS AND HABITATS OF BIRDS IN PONDEROSA

Annual Progress Report MSU#02-JV-11221607-250
Analysis of Fire Effects on Populations and habitats of Birds in Ponderosa Pine Forests
January 2006

Title of Project: Birds and Burns Network - Analysis of Fire Effects on Populations and habitats of Birds in Ponderosa

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Project Description

Fire has been an important ecological process in shaping forested landscapes and animal distributions in the SFSR sub-basin. Alterations in the structure and composition of forests in the sub-basin as a result of 60-70 years of fire suppression have also changed the structure of animal populations. Yet we do not have an understanding of the implications of fire exclusion on wildlife populations or their habitats. Objectives of the project are to use prescribed fire for three purposes: (1) restore fire to the ponderosa pine ecosystem; (2) reduce accumulation of fuels; and (3) improve wildlife and fish habitat. Effectiveness monitoring is conducted to quantitatively evaluate whether objectives of reducing fuels are met, and to assess effects of the potential fuel reductions on habitat and populations of focal wildlife species. The SFSR sub-basin provides habitat for both wildlife and fish TES species, including three Sensitive Species of woodpeckers (white-headed, black-backed and Lewis's woodpeckers) and four listed TES salmonid species. Little is known about how these species respond to prescribed fire treatments for ecosystem restoration, fire exclusion, or stand-replacing fire. The project will address information gaps by monitoring forest vegetation characteristics, woodpecker nesting densities and nest survival, and songbird densities before and after prescribed fire treatments, and by comparing that data to existing information on bird responses to stand-replacement fires. This project will help managers display trade-offs associated with different fire conditions (no fire, prescribed fire, and stand-replacing fire), identify potential conflicts in TES management, and assess potential benefits of habitat restoration. During Fiscal Year (FY) 2002, the Joint Fire Sciences Program (01-1-3-25: Prescribed fire strategies to restore wildlife habitat in ponderosa pine forests of the Intermountain West [Saab, Kotliar, Block]) and the National Fire Plan (02.RMS.C.2: Effects of wildland fire and fuel treatments on populations and habitats of terrestrial vertebrates in Intermountain forests [Block and Saab]) awarded matching funds for 3-5 years to help continue this work and implement the protocol and design on forests in seven other states across the western United States, known as the "*Birds and Burns Network*" (see web page http://www.rmrs.nau.edu/birdsnburns). The project implements the Forest Service Natural Resource Agenda by increasing prescribed fire and forest fuel treatments in a critical watershed (under "Watershed Health and Restoration"), and by working with state, local and other partners toward sustainable forest ecosystem management (under "Sustainable Forest Ecosystem Management").

Partners

Partners in FY 2005 include the Payette NF (PNF), Rocky Mountain Research Station (RMRS), Forest Service Intermountain Region (R4) Fire Program, Pacific Northwest Research Station (PNW-Wenatchee Lab), Idaho Dept. of Fish & Game (IDFG), and Montana State University (MSU) Ecology Department. The following is a description of each partner's contribution. PNF fire program (Sam Hescock) provides funding, field housing, transportation, and equipment. PNF is also integrating field information with Forest Service management needs. PNF provides funding for field crews and for purchasing equipment. RMRS is responsible for the design and supervision of the field studies, development of a monitoring plan, collecting and analyzing field data, providing field equipment, and completing technical reports and publications. IDFG provides funding for field assistants. R4 fire program (Dave Thomas) provides funding for vehicles and data collection. Lisa Bate (contract biologist with the Pacific Northwest Research Station) provides assistance with the sampling design and analyses of the vegetation data. MSU provided facilities for graduate students and is assisting with database management and data analysis. The project builds a sustainable partnership among agencies, research community, and conservation groups.

Study Site Selection

The study area is encompassed by the South Fork of the Salmon River Sub-basin on the PNF in Valley County, Idaho (Figure 1). A common sampling design is shared for monitoring all indicators, including wildlife populations and upland vegetation. Areas identified for prescribed fire were at about ~500 acres (300 ha) in size, dominated by ponderosa pine cover types (i.e., working group strata identified by the PNF), between 3,500'-6,500' (1,060 m – 2,000 m), and with streams that provide habitat for amphibians. The 500-acre units were selected in pairs. One of the paired units was selected for burning, while the other unit will remain unburned. This provides a design with a control plot that remains unburned, and a treated plot that is monitored before and after prescribed fire. Three paired units or replicates were selected for pre-treatment monitoring in 1999 through 2005. The units were selected on the basis of prescribed fire opportunities/priorities that were identified by the Payette National Forest. We used maps produced by Brad Sanders (PNF) that identified the areas for restoration priority (spring followed by a fall application of prescribed fire) or maintenance priority (fall application of prescribed fire). From west to east, the paired units include Fitsum (FC) and Buckhorn (BH), Williams (WM) and Dutchoven (DO), and Deadman (DM) and Parks (PC) (Figure 1).

Methods

Pre-treatment data have been collected during May-September 1999-2005. With the initiation of the Birds and Burns Network (BBN) in 2002, field protocols were refined based on input from our collaborators in the BBN. Detailed instructions and field forms our available online at http://www.rmrs.nau.edu/lab/4251/birdsnburns/info_partic.shtml. Field season 1999 was a pilot effort in which we conducted an inventory of cavity-nesting birds, cursory nest surveys, and vegetation sampling. During 2000-2005, nest surveys and monitoring, point count surveys, and vegetation sampling were conducted at six units in the study area (Figure 1). Methods for nest surveys and monitoring are outlined in Dudley and Saab (2003), available at http://www.rmrs.nau.edu/lab/4251/pubs/rmrs_rp044.pdf. Point counts were located in each stratum (open vs. closed canopy) within the six study units. Point counts were conducted for 5 minutes and birds were recorded at 5 distance categories. Numbers of individuals by species were recorded within distances of 0-10 m; 10-25 m; 25-50 m; 50-75 m; 75-100 m; >100 m from the center of the point count station. Point count data from 2000-2001 were analyzed to determine the sample sizes needed to obtain reasonable precision levels (20-30% of the true mean with a 90% confidence level) for ground- and shrub- nesting bird species (Buckland et al. 2000). Twenty point count stations were established in each of five units, and 10 stations at Williams Creek unit, for a total of 110 point count stations. Stations were located at least 200 m apart. A global positioning system (GPS) was used at each point count location and nest to determine topographical position, recorded as latitude/longitude (later converted to UTMs), and elevation accurate within 3 m.

From 1999-2005, vegetation measurements were taken once at 20 stratified random locations in each of five units, and 10 locations at Williams Creek, for a total of 110 vegetation plots (corresponding to point count stations), and at 190 nest sites. All pre-treatment vegetation data through 2004 have been collected and summarized. Random locations were stratified by cover type/structural stage as defined by the PNF working-group strata. These random stations are being used to describe the habitats available to birds for the analysis of habitat selection and to describe the vegetation before and after prescribed fire. Vegetation charcteristics have been measured for 173 pre-treatment nests, 5 "year-of-treatment" nests and 12 "post-treatment" nests.

Vegetation sampling is nested at each nest and point count (stratified random) location and measured within two 20 m x 100 m rectangular plots that cross in the center (Figure 2). Tree and snag measurements follow methods outlined by Bate et al. (1999), and logs by Bate et al. (2004). Methods for ground, shrub, and canopy cover follow those described for BBIRD (Martin and Guepel 1993, Ralph et al. 1993) with some modifications. Vegetation measurements for tree canopy, ground cover, and shrub densities are measured in three 5-m radius circular plots. Plant species composition is recorded for all woody vegetation (Appendix 1). Post-treatment vegetation measurement included assessment of burn-severity on a variety of vegetation characteristics (e.g., bare ground, tree and snag boles, and live tree canopy). Methods for burn-severity assessment were adapted from Jain and Graham (2004). Nest tree measurements included nest height, cavity age, species that excavated the cavity, orientation of the cavity (cf. Raphael and White 1984).

Preliminary Results

Prescribed Fire Treatment

Prescribed fire was implemented during the week of 3 May 2004 by the PNF. The purpose of the treatment was fivefold: to reduce hazardous fuels, to provide the first step toward returning ponderosa pine/Douglas-fir timber types to historical stand densities, to provide protection from wildfire to the nearby community of Yellow Pine, to provide research support to the Joint Fire Sciences Project, and to improve wildlife habitat (see Parks-Eiguren Prescribed Burn Plan). The size of the project was anticipated to be 2500 acres, which included the ~ 500 acre Parks unit. A buildup of a shade-tolerant understory (which act as ladder fuels) due to "one or more missed fire return intervals" necessitated the prescribed burning. Specific objectives for reduction of fuels by size class can be found in the Parks-Eiguren Prescribed Burn Plan (USDA 2004). Aerial ignition to create strip-head firing was implemented and burning was initiated at top boundary of units and allowed to back downhill. Burning conditions matched the planned conditions well (Table 1). Two years of post-treatment monitoring have been completed on the Parks unit. Data collected in 2004 on the treated unit are considered "year-of-treatment", as small spot fires smoldered into late May and nesting species were likely displaced. Surveys in 2005 are designated as "1 year post-treatment" and showed an increase in nesting density and diversity of cavity-nesting birds. Point counts were also conducted in both treatment years. Twenty random vegetation plots on the treated unit were re-measured in 2005 and will be compared to the pre-treatment data. The Dutch Oven and Fitsum Creek prescribed fires were not implemented in the 2005 season.

Vegetation

Vegetation data were collected in two strata that correspond to the working group strata defined by the Payette National Forest. Stratum 1 was typically 10%--35% crown closure, dominated by ponderosa pine (see Appendix 1 for scientific names of woody vegetation). Stratum 2 was generally >35%--70% crown closure, composed of mixed conifer tree species. Snag, tree, log, ground, shrub and canopy cover data were collected at all units during 1999-2005.

Snag densities (> 23 cm dbh) at random plots and nest plots differed markedly. Pre-treatment nest plots had snag densities more than twice that of random plots (Figure 6). Cavity-nesting birds also choose cavity trees that are much larger in diameter than random snags (Figure 4). Snags measured within nest plots used by cavity-nesting birds were also larger in diameter than random snags (Figure 4). Though nest plots have lower densities of live trees (<23 cm dbh) (Figure 7), the differences are likely not statistically significant.

The prescribed fire treatment implemented in May 2004 increased snag densities measured at random locations (Figure 5), however the precision around these estimates was poor. Live tree densities were not affected greatly by the prescribed fire treatment.

Point Counts

We recorded 58 bird species during point count surveys in 2005 (Table 3; scientific names are listed in Appendix 2). A total of 75 bird species have been observed in the study area since 1999 (Table 3). Yellow-rumped Warbler, Western Tanager, Chipping Sparrow, Red-breasted Nuthatch, and Hammond's Flycatcher were the five most detected species during point counts in years 2002 through 2005 (Figure 3). Eighteen of the 25 most abundant bird species were detected in greater abundance in the open canopy stratum. Point count data allow us to estimate density, relative abundance, and composition of songbirds at various spatial scales in two strata. In addition, our long-term approach will allow us to examine temporal variation in this system.

Preliminary analysis of point count data using program DISTANCE were conducted using 2002 and 2003 data. Eight species have been detected during point counts in sufficient numbers to warrant formal DISTANCE analysis, these are: American Robin, Chipping Sparrow, Dark-Eyed Junco, Red Breasted Nuthatch, Yellow-rumped warbler, Hammond's Flycatcher, and Western Tanager. Densities computed for top ten species detected during points counts tended to be similar for both pre-treatment and control units (Table 5).

Nest Monitoring

Thirty-five nests of nine species were monitored during 2005 (Table 2) compared to thirty-three nests of five species in 2004. The nesting of two known burn specialist species, Black-backed woodpecker (*Picoides arcticus*) and Three-toed woodpecker (*Picoides tridactylus*) in the recently burned Parks unit increased both the nesting density and nesting species diversity on that unit. The density of primary cavity-nesting birds doubled on this unit in the 2005 breeding season as compared to the past four years. Black-backed and three-toed woodpeckers have been encountered on many of the units in past years during the later part of the breeding season but only one recorded breeding attempt (three-toed woodpecker) was recorded before fire treatments. Black-backs and three-toed woodpeckers both had high nest survival in 2005, one year after prescribed fire. Also in the burned unit during 2005, five of six nests were successful. We anticipate that nesting densities will continue to increase for the next 2-3 years in the treated unit.

The two most abundant nesting species are northern flicker (*Colaptes auratus*) and Hairy Flicker (*Picoides villosus*). Northern Flicker fledged young successfully in 56 out of 92 attempts (apparent nest survival = 60%). Estimated nest survival for northern flickers using a maximum likelihood approach (Dinsmore et al. 2002) is 0.50 with 95% confidence interval (0.37, 0.611). Successful nests produced between 1 and 6 young with an average of 2.6 young fledged. This productivity estimate may be biased low, however, as many nests were too tall to view directly (e.g., higher than the camera pole). Hairy woodpeckers fledged young successfully in 30 out of 43 attempts. Apparent nest survival for hairy woodpeckers is 69%, but maximum likelihood estimate is 0.46 with

95% confidence interval (0.29, 0.62). Hairy woodpeckers fledged two young on average with a range of 1-5 young per nest.

Future Plans

Plans for 2005 are to monitor Parks Creek (treatment unit) and Deadman (control unit) to obtain 2 year post-treatment data. NEPA for the two remaining treatment units (Fitsum and Dutch Oven) was completed in 2005I and implementation will be at the discretion of the Fire Management Officer the Payette National Forest. Vegetation and bird monitoring are planned for two years post-treatment (2007-2008) if Fitsum and Dutch Oven are burned in 2006. Modeling of nest survival and nest-site selection using vegetation covariates will be conducted in 2006. Point count analysis including vegetation covariates will be conducted in 2006 using program DISTANCE and data from multiple study locations.

Tables & Figures

Table 1. Attributes of Parks prescribed fire treatment unit.

Attribute	Measurement
Burned Acreage	*2500*
Average Temperature (F)	*< 79*
Average Relative Humidity (%)	*> 25*
Wind Speeds (mph)	*0 - 8*
Flame lengths (inches)	*N/A*
Fuel moistures	
1 -hour (%)	*8 -15*
10 -hour (%)	*10 -18*

Table 2. Nests monitored from 1999 through 2005.

	Pre-Treatment Nests - All									
	BBWO	HAWO	MOBL	NOFL	PIWO	RNSA	TTWO	WEBL	WISA	Total
1999				2	1					3
2000		6	1	8	2			1	1	19
2001		6	1	15	2	2		1	1	28
2002		13	1	13	3	2		2	1	35
2003		9		22	2	3	1		1	38
2004		5		19	1	2				27
2005		4	2	13	1	2		1		23
Total	**0**	**43**	**5**	**92**	**12**	**11**	**1**	**5**	**4**	**173**
	Pre-Treatment Nests - Successes									
	BBWO	HAWO	MOBL	NOFL	PIWO	RNSA	TTWO	WEBL	WISA	Total
1999				1	1					2
2000		4	1	5	2			1	1	14
2001		6		9	2	2		1	1	21
2002		8	1	8	3	2			1	23
2003		6		16	2	2			1	27
2004		3		8	1	2				14
2005		3	1	9		2		1		16
Total	**0**	**30**	**3**	**56**	**11**	**10**	**0**	**3**	**4**	**117**
	Pre-Treatment Nests Failures									
	BBWO	HAWO	MOBL	NOFL	PIWO	RNSA	TTWO	WEBL	WISA	Total
1999				1						1
2000		2		3						5
2001			1	6						7
2002		5		5				2		12
2003		3		6		1	1			11
2004		2		11						13
2005		1	1	4	1					7
Total	**0**	**13**	**2**	**36**	**1**	**1**	**1**	**2**	**0**	**56**
	"year-of-treatment" (2004) Nests									
	BBWO	HAWO	MOBL	NOFL	PIWO	RNSA	TTWO	WEBL	WISA	Total
Successes		1							1	2
Failures				1	1	1				3
Total	**0**	**1**	**0**	**1**	**1**	**1**	**0**	**0**	**1**	**5**
	"Post-Treatment Year 1" (2005) Nests									
	BBWO	HAWO	MOBL	NOFL	PIWO	RNSA	TTWO	WEBL	WISA	Total
Successes	2	2			1	1	3			9
Failures	1				1				1	3
Total	**3**	**2**	**0**	**0**	**2**	**1**	**3**	**0**	**1**	**12**
								Grand Total		**190**

Table 3. Total number of detections of bird species by year recorded during the 2002 through 2005 field seasons. The list only includes species that were recorded within the 100 meter radius for use in analysis in program DISTANCE (flyovers and detections > 100 meters omitted).

SPP	2002	2003	2004	2005
AMKE	0	5	1	0
AMRO	95	83	78	118
BBWO	0	2	0	5
BCCH	3	0	0	1
BCHU	0	0	0	2
BEKI	0	0	0	1
BHGR	2	4	2	0
BLUG	4	10	6	12
BRCR	27	19	23	7
BTAH	1	0	1	0
CAFI	42	36	36	84
CAHU	5	9	4	4
CANW	1	0	1	2
CAVI	54	26	24	29
CEDW	0	0	2	0
CHSP	189	212	163	186
CLNU	16	7	0	6
COGA		0		
COHA	1		0	1
CONI	0	0	1	0
CORA	4	3	0	8
DEJU	117	62	51	34
DUFL	19	15	44	22
EVGR	4	0	1	3
FLOW	1	0	0	0
GCKI	1	0	2	0
GOEA	0	0	0	1
GRAJ	2	6	5	5
HAFL	165	218	149	178
HAWO	24	28	21	17
HETH	17	20	29	63
HOWR	3	0	0	2
LAZB	1	1	0	1
MGWA	31	34	20	28
MOBL	3	0	0	1
MOCH	96	102	58	90
NAWA	17	9	5	19
NOFL	17	9	12	32
NOGO	2	0	0	1

Table 3 (continued). Total number of detections of bird species by year recorded during the 2002 through 2005 field seasons. The list only includes species that were recorded within the 100 meter radius for use in analysis in program DISTANCE (flyovers and detections > 100 meters omitted).

SPP	2002	2003	2004	2005
NOPO	1	0	0	0
OCWA	3	3	7	5
OSFL	0	0	2	5
OSPR	0	0	0	1
PISI	16	13	25	47
PIWO	1	2	3	6
RBNU	167	178	121	96
RCKI	11	11	6	18
RECR	39	22	1	86
RNSA	0	0	1	6
ROWR	4	2	1	5
RTHA	2	2	1	4
RUGR	3	4	1	6
RUHU	0	0	1	0
SOSP	1	2	1	4
SPSA	0	0	0	3
SPTO	1	2	1	0
SSHA	0	1	0	0
STJA	3	2	4	4
SWTH	17	25	29	22
TOSO	33	25	22	44
TOWA	47	28	18	30
TTWO	0	0	0	4
VASW	0	0	0	1
WAVI	35	43	50	65
WBNU	8	4	8	12
WETA	222	243	136	190
WEWP	4	3	2	0
WISA	1	5	0	0
WIWA	0	1	0	2
WIWR	7	2	1	10
WWPE	0	0	0	1
YRWA	261	294	211	232

Table 4. Temperature and precipitation from RAWS Teapot station (near BH unit) for 1999 through 2005.

	1999	2000	2001	2002	2003	2004	2005
Annual Precip (cm)	-	39	21	33	48	47	55
May 1 - Sept 1 Temperatures (F)							
Average	61.8	60.6	60.8	59.5	62.1	58.8	59.0
Max	96.9	98.9	95.9	104.9	99.9	96.9	95.9
Min	29.9	26.9	25.9	20.9	22.9	30	27.9
June 1 - July 1 Temperatures (F)							
Average	55.3	59.3	56.8	58.3	60.5	58.4	52.7
Max	91.9	88.9	88.9	94.9	91.9	88.9	87.9
Min	29.9	31.9	31.9	31.9	31.9	33.9	31.9

Figure 1. Study site location and treatment/control pairs.

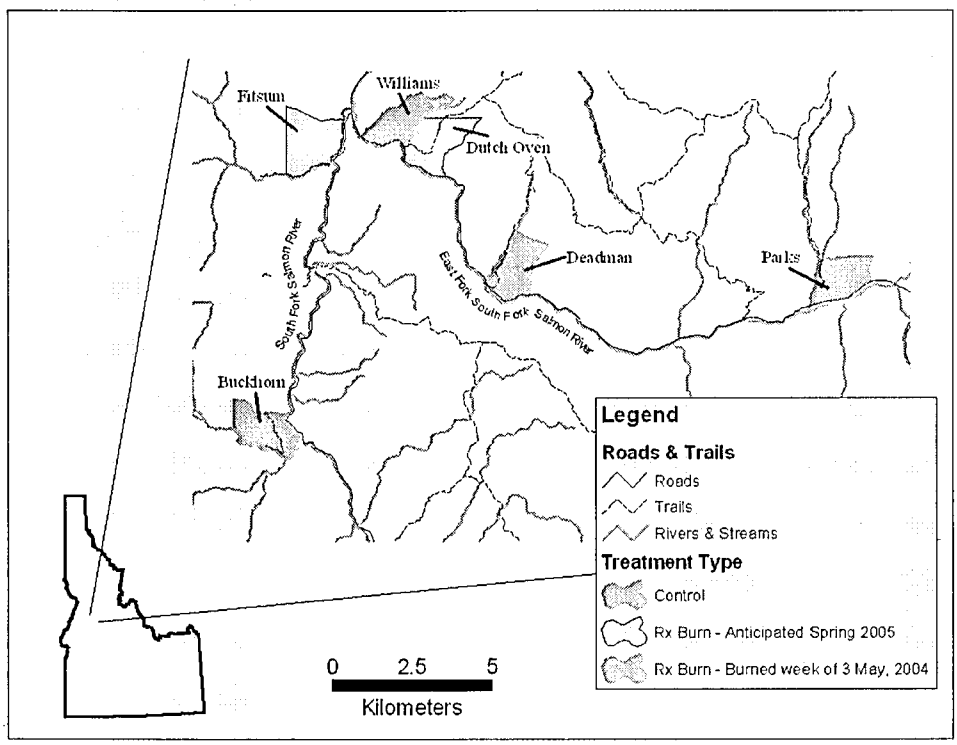

Figure 2. Plot design surrounding nest and random trees.

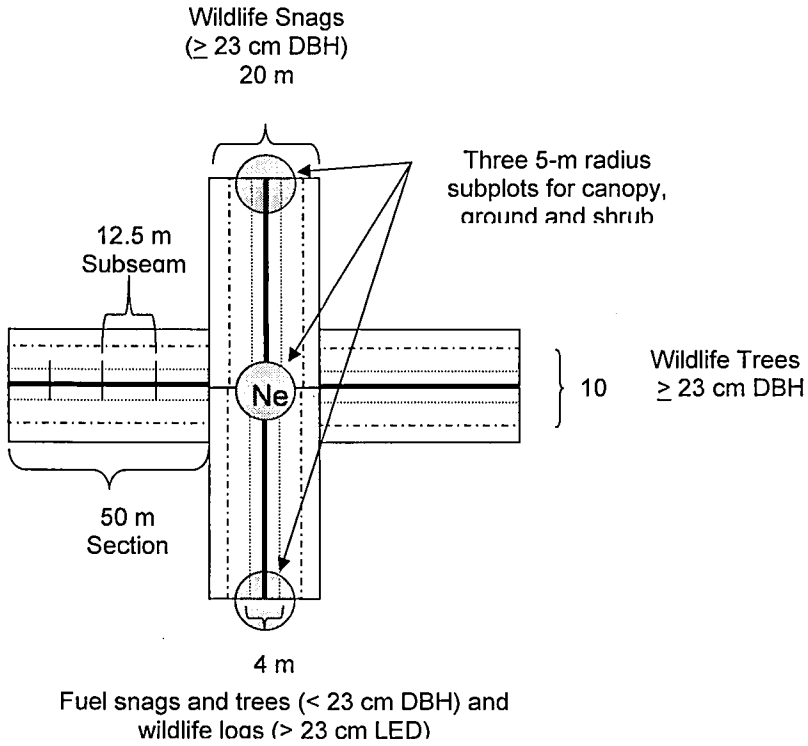

Figure 3. Number of detections of top sixteen most detected species by year (+ Red Squirrel). Figures include detections at the prescribed fire unit (Parks).

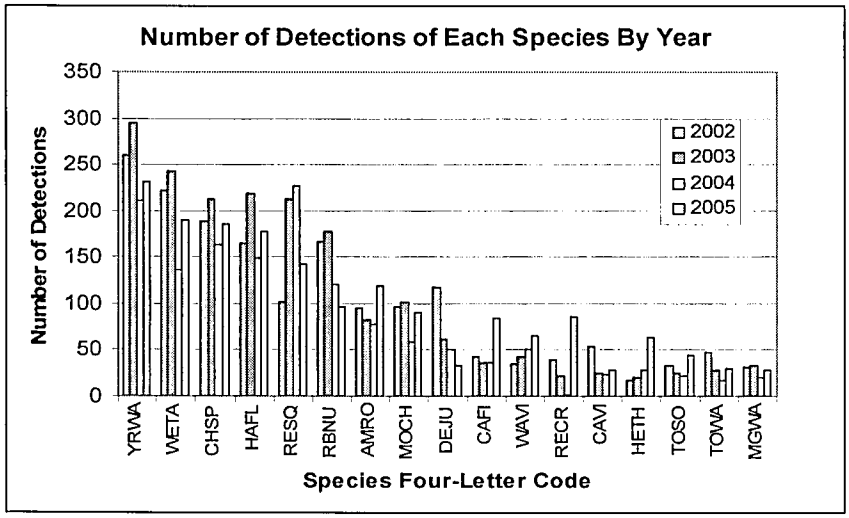

Figure 4. Comparison of snag diameters at random plots, nest plots, and cavity trees on all units 1999-2002.

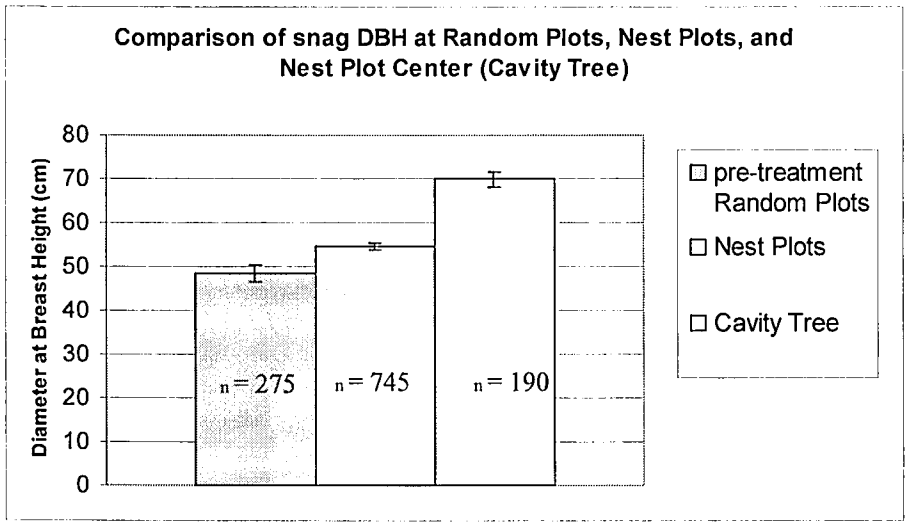

Figure 5. Snag Density at random plots befoe and after prescribed fire on Parks (treated) unit.

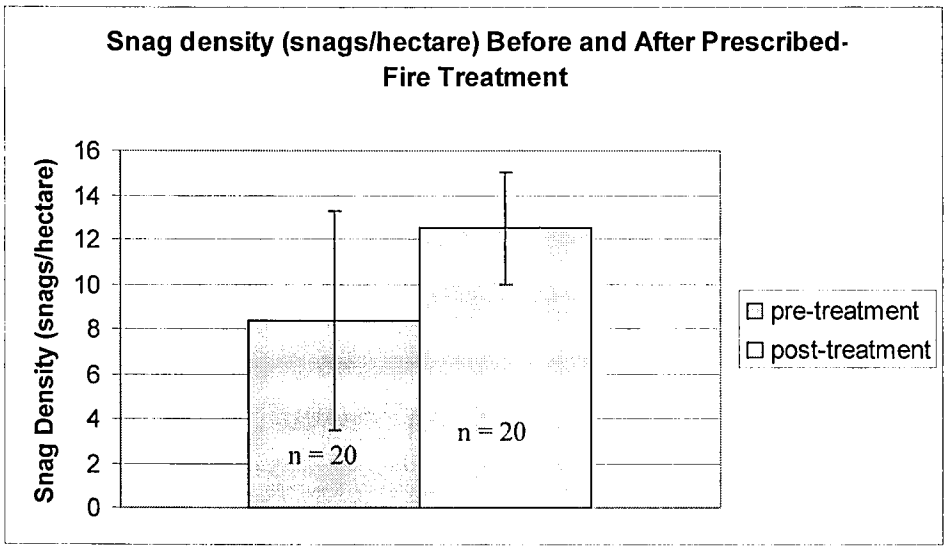

Figure 6. Snag Densities at Random and Nest Plots (pre-treatment) on all units 1999-2002 (except "year-of-treatment" and "post-treatment year 1 on Parks unit).

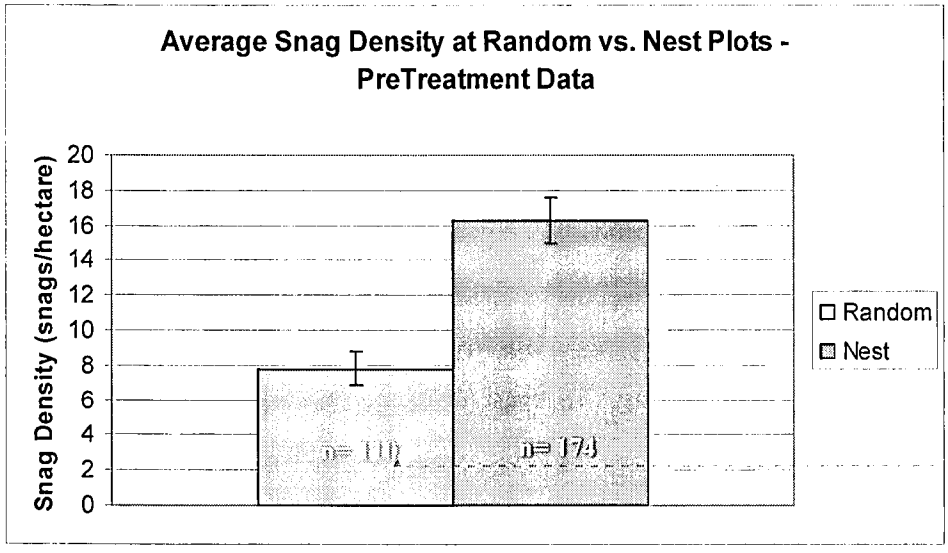

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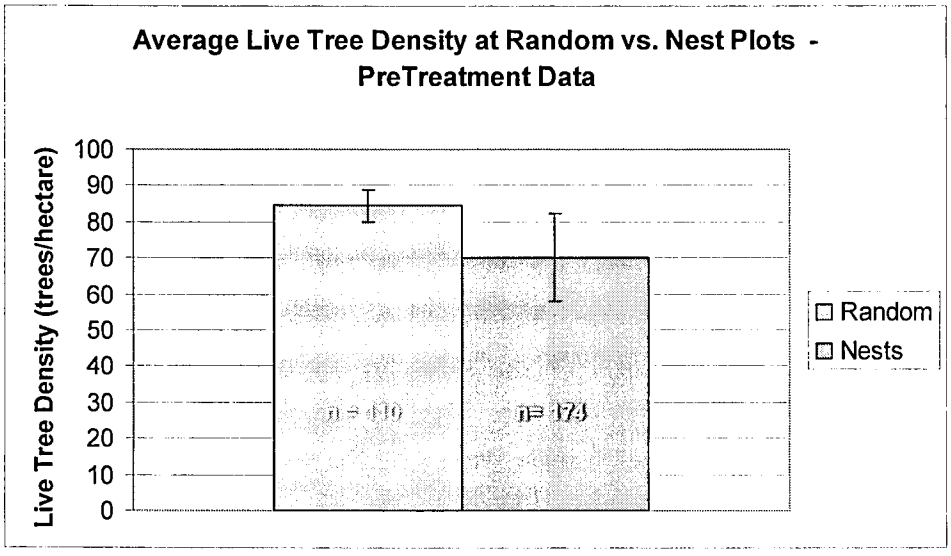
Figure 7. Live tree densities at Random and Nest Plots (pre-treatment). on all units 1999-2002 (except "year-of-treatment" and "post-treatment year 1 on Parks unit).



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Appendices

Appendix 1. Common and scientific names of woody vegetation recorded within the South Fork Salmon study areas during 1999-2004.

Common name	Scientific name
Grand Fir	*Abies grandis*
Subalpine Fir	*Abies lasiocarpa*
Rocky Mountain Maple	*Acer glabrum*
Mountain Alder	*Alnus incana*
Sitka Alder	*Alnus sinuata*
Western Serviceberry	*Amelanchier alnifolia*
Bearberry, Kinnikinnick	*Arctostaphylos uva-ursi*
Creeping Oregongrape	*Berberis repens*
Mountain Balm	*Ceanothus velutinus*
Curleaf Mountain-Mahogany	*Cercocarpus ledifolius*
Red-osier Dogwood	*Cornus stolonifera*
Black Hawthorn	*Crataegus douglasii*
Utah Honeysuckle	*Lonicera utahensis*
Fool's Huckleberry	*Menziesia ferruginea*
Mock Orange	*Philadelphus lewisii*
Mallow Ninebark	*Physocarpus malvaceus*
Lodgepole Pine	*Pinus contorta*
Engelman Spruce	*Picea engelmannii*
Ponderosa Pine	*Pinus ponderosa*
Quaking-aspen	*Populus tremuloides*
Bittercherry	*Prunus emarginata*
Common Chokecherry	*Prunus virginiana*
Douglas-fir	*Pseudotsuga menziesii*
Bitterbrush	*Purshia tridentate*
Squaw Currant	*Ribes cereum*
Swamp Gooseberry	*Ribes lacustre*
Sticky Currant	*Ribes viscosissimum*
Currant	*Ribes spp.*
Baldhip Rose	*Rosa gymnocarpa*
Wood's Rose	*Rosa woodsii*
Rose	*Rosa spp.*
Thimbleberry	*Rubus parviflorus*
Elderberry	*Sambucus cerulea*
Scouler Willow	*Salix scouleriana*
Salix	*Salix spp.*
Buffaloberry	*Shepherdia Canadensis*
Mountain Ash	*Sorbus scopulina*
White Spirea	*Spirea betulifolia*
Common Snowberry	*Symphoricarpos albus*
Mountain Snowberry	*Symphoricarpos oreophilus*
Snowberry	*Symphoricarpos spp.*
Big Huckleberry	*Vaccinium membranaceum*

Appendix 2. Common and scientific names of birds detected during point count surveys 2002 - 2004.

Four-Letter Code	Common Name	Scientific Name
SSHA	Sharp-shinned Hawk	*Accipiter striatus*
COHA	Cooper's Hawk	*Accipiter cooperii*
NOGO	Northern Goshawk	*Accipiter gentilis*
RTHA	Red-tailed Hawk	*Buteo jamaicensis*
AMKE	American Kestrel	*Falco sparverius*
RUGR	Ruffed Grouse	*Bonasa umbellus*
BLUG	Blue Grouse	*Dendragapus obscurus*
FLOW	Flammulated Owl	*Otus flammeolus*
NOPO	Northern Pygmy-Owl	*Glaucidium gnoma*
CONI	Common Nighthawk	*Chordeiles minor*
CAHU	Calliope Hummingbird	*Stellula calliope*
BTAH	Broad-tailed Hummingbird	*Selasphorus platycercus*
RUHU	Rufous Hummingbird	*Selasphorus rufus*
WISA	Williamson's Sapsucker	*Sphyrapicus thyroideus*
RNSA	Red-naped Sapsucker	*Sphyrapicus nuchalis*
HAWO	Hairy Woodpecker	*Picoides villosus*
BBWO	Black-backed Woodpecker	*Picoides arcticus*
NOFL	Northern Flicker	*Colaptes auratus*
PIWO	Pileated Woodpecker	*Dryocopus pileatus*
OSFL	Olive-sided Flycatcher	*Contopus cooperi*
WEWP	Western Wood-Pewee	*Contopus sordidulus*
HAFL	Hammond's Flycatcher	*Empidonax hammondii*
DUFL	Dusky Flycatcher	*Empidonax oberholseri*
CAVI	Cassin's Vireo	*Vireo cassinii*
WAVI	Warbling Vireo	*Vireo gilvus*
GRAJ	Gray Jay	*Perisoreus canadensis*
STJA	Steller's Jay	*Cyanocitta stelleri*
CLNU	Clark's Nutcracker	*Nucifraga columbiana*
CORA	Common Raven	*Corvus corax*
BCCH	Black-capped Chickadee	*Poecile atricapilla*
MOCH	Mountain Chickadee	*Poecile gambeli*
RBNU	Red-breasted Nuthatch	*Sitta canadensis*
WBNU	White-breasted Nuthatch	*Sitta carolinensis*
BRCR	Brown Creeper	*Certhia americana*
ROWR	Rock Wren	*Salpinctes obsoletus*
CANW	Canyon Wren	*Catherpes mexicanus*
HOWR	House Wren	*Troglodytes aedon*
WIWR	Winter Wren	*Troglodytes troglodytes*
GCKI	Golden-crowned Kinglet	*Regulus satrapa*
RCKI	Ruby-crowned Kinglet	*Regulus calendula*
MOBL	Mountain Bluebird	*Sialia currucoides*
TOSO	Townsend's Solitaire	*Myadestes townsendi*
SWTH	Swainson's Thrush	*Catharus ustulatus*
HETH	Hermit Thrush	*Catharus guttatus*

Appendix 2. (continued)

AMRO	American Robin	*Turdus migratorius*
CEDW	Cedar Waxwing	*Bombycilla cedrorum*
OCWA	Orange-crowned Warbler	*Vermivora celata*
NAWA	Nashville Warbler	*Vermivora ruficapilla*
YRWA	Yellow-rumped Warbler	*Dendroica coronata*
AUWA	Audubon's Warbler	*Dendroica c. auduboni*
TOWA	Townsend's Warbler	*Dendroica townsendi*
MGWA	MacGillivray's Warbler	*Oporornis tolmiei*
WIWA	Wilson's Warbler	*Wilsonia pusilla*
WETA	Western Tanager	*Piranga ludoviciana*
SPTO	Spotted Towhee	*Pipilo maculatus*
CHSP	Chipping Sparrow	*Spizella passerina*
SOSP	Song Sparrow	*Melospiza melodia*
DEJU	Dark-eyed Junco	*Junco hyemalis*
BHGR	Black-headed Grosbeak	*Pheucticus melanocephalus*
LABU	Lazuli Bunting	*Passerina amoena*
CAFI	Cassin's Finch	*Carpodacus cassinii*
RECR	Red Crossbill	*Loxia curvirostra*
PISI	Pine Siskin	*Carduelis pinus*
EVGR	Evening Grosbeak	*Coccothraustes vespertinus*